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Application number : PCT/SG02/00042 [WITHDRAWN]

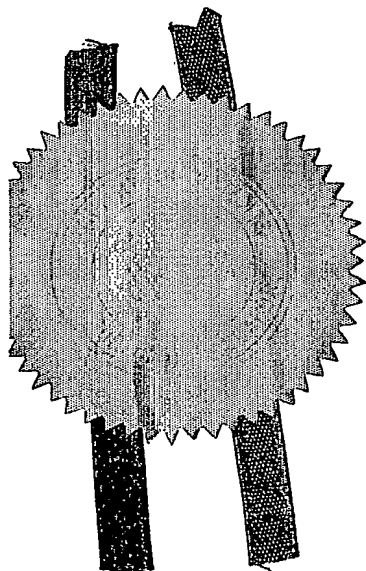
Applicants : PHILIPS ELECTRONICS SINGAPORE PTE LTD


Title of Invention : FRONT STAGE AMPLIFIER

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SG020006WOP

## PCT REQUEST

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0	For receiving Office use only	
0-1	International Application No.	PCT/SG 02 / 00042
0-2	International Filing Date	13 MAR 2002 (13-03-02)
0-3	Name of receiving Office and "PCT International Application"	REGISTRY OF PATENTS (SINGAPORE) PCT INTERNATIONAL APPLICATION
0-4	Form - PCT/RO/101 PCT Request	
0-4-1	Prepared using	PCT-EASY Version 2.92 (updated 01.01.2002)
0-5	Petition The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty	
0-6	Receiving Office (specified by the applicant)	Intellectual Property Office of Singapore (RO/SG)
0-7	Applicant's or agent's file reference	SG020006WOP
I	Title of invention	FRONT STAGE AMPLIFIER
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## PCT REQUEST

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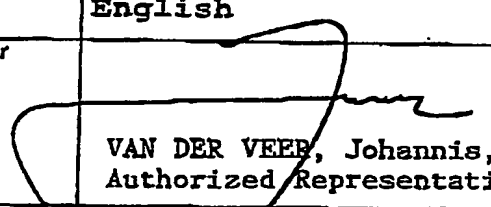
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<b>V</b>	<b>Designation of States</b>		
<b>V-1</b>	Regional Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	EP: AT BE CH&LI CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE and any other State which is a Contracting State of the European Patent Convention and of the PCT (except TR)	
<b>V-2</b>	National Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	SG	
<b>V-5</b>	Precautionary Designation Statement  In addition to the designations made under items V-1, V-2 and V-3, the applicant also makes under Rule 4.9(b) all designations which would be permitted under the PCT except any designation(s) of the State(s) indicated under item V-6 below. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit.		
<b>V-6</b>	Exclusion(s) from precautionary designations	NONE	
<b>VI</b>	Priority claim	NONE	
<b>VII-1</b>	International Searching Authority Chosen	European Patent Office (EPO) (ISA/EP)	
<b>VIII</b>	<b>Declarations</b>	<b>Number of declarations</b>	
<b>VIII-1</b>	Declaration as to the identity of the inventor	-	
<b>VIII-2</b>	Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent	-	
<b>VIII-3</b>	Declaration as to the applicant's entitlement, as at the international filing date, to claim the priority of the earlier application	-	
<b>VIII-4</b>	Declaration of inventorship (only for the purposes of the designation of the United States of America)	-	
<b>VIII-5</b>	Declaration as to non-prejudicial disclosures or exceptions to lack of novelty	-	
<b>IX</b>	<b>Check list</b>	<b>number of sheets</b>	<b>electronic file(s) attached</b>
<b>IX-1</b>	Request (including declaration sheets)	3	-
<b>IX-2</b>	Description	5	-
<b>IX-3</b>	Claims	2	-
<b>IX-4</b>	Abstract	1	EZABST00.TXT
<b>IX-5</b>	Drawings	2	-
<b>IX-7</b>	TOTAL	13	

## PCT REQUEST

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	Accompanying items	paper document(s) attached	electronic file(s) attached
IX-8	Fee calculation sheet	✓	-
IX-11	Copy of general power of attorney	✓	-
IX-17	PCT-EASY diskette	-	Diskette
IX-19	Figure of the drawings which should accompany the abstract	1	
IX-20	Language of filing of the international application	English	
X	Signature of applicant, agent or common representative		
X-1	Name (LAST, First)	VAN DER VEER, Johannis, L.	
X-2	Capacity	Authorized Representative	

## FOR RECEIVING OFFICE USE ONLY

10-1	Date of actual receipt of the purported international application	13 MAR 2002 (13-03-02)
10-2	Drawings:	
10-2-1	Received	
10-2-2	Not received	
10-3	Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application	
10-4	Date of timely receipt of the required corrections under PCT Article 11(2)	
10-5	International Searching Authority	ISA/EP
10-6	Transmittal of search copy delayed until search fee is paid	

## FOR INTERNATIONAL BUREAU USE ONLY

11-1	Date of receipt of the record copy by the International Bureau	
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## Front stage amplifier

## FIELD OF THE INVENTION

The invention relates in general to amplifiers and more specifically to amplifiers typically used in radio frequency (RF) receivers.

## 5 BACKGROUND OF THE INVENTION

Amplifiers are used for amplifying input RF signals to receivers such as TV tuners, multimedia tuners and tuners for PCs.

Presently in a TV tuner (TV set) for instance, there exist different types of amplifiers, for instance a low noise amplifier (LNA) type amplifier with a bypass or a power  
10 splitter type amplifier.

These two concepts have been used until today by most of the TV set manufacturers, but both concepts have disadvantages. A LNA for instance with a high gain and low noise is not able to handle normal cable TV signals and a power splitter amplifier that is able to handle such signals has relatively high noise. These both drawbacks imply  
15 problems when a TV set for instance should be connectable to both a cable TV system as well as to a conventional antenna and at the same time perform high quality.

JP-A-10084500 describes a LNA for improved sensitivity especially for low-level signals with a sensor for a certain threshold. The LNA is not useable as a splitter for strong cable signals for instance, since the bypass suffers from implementation loss.

20

## SUMMARY OF THE INVENTION

It is an object of the invention to provide an amplifier that has optimal signal output for weak signals as well as for strong signals.

Herein, a strong signal is referred to as a signal having a strength comparable  
25 to a cable TV signal, a weak signal is referred to as a signal having a strength comparable to a signal from a conventional outdoor antenna.

Herein, the term "strong signal" typically refers to signals  $> 1$  mV, the term "medium signal" typically refers to signals  $> 316$   $\mu$ V but  $< 1$  mV and the term "weak" typically refers to signals  $< 316$   $\mu$ V. These values are not absolute, but an example. Signal

values that are outside these values but having a similar size are also within the scope of the invention as defined in the claims.

According to a first aspect of the invention, the object is obtained by a multi-mode amplifier that can be switched between high gain in case of a weak signal and low gain in case of a strong signal.

In this way, the amplifier can have different characteristics for different signals; in particular for hybrid analog/digital tuners this is of great importance.

According to a preferred embodiment of the invention, there is provided an amplifier device, the amplifier device comprising:

amplifier means for amplifying a radio frequency (RF) input signal,

a controllable feedback loop for adjusting a gain and a bias voltage applied to the amplifier means for adjusting a current determining a noise level, arranged to provide at least two different modes, a first mode providing high gain and low noise for handling weak signals and a second mode providing low gain power splitting for handling strong signals.

Depending on the input signal received the mode can be selected, which results in the optimal signal output.

Preferably the amplifier device comprises a mode selection circuitry and the feedback loop that is connected between an output and an input of the amplifier means, comprises at least two resistors, a first resistor, and a second resistor connected in parallel to each other, wherein the second resistor is connected in series with a switch controlled by the mode switching circuitry, which mode switching circuitry also controls a bias voltage applied to the amplifier means. This is a cost-effective solution when requiring 2 modes to deliver optimal signal outputs whether receiving a strong or weak input signal.

Preferably, the mode selection circuitry controls the feedback loop and the bias voltage to provide a third mode providing high gain and high current. This third mode delivers an optimal signal output, when receiving a medium level input signal.

According to another embodiment of the invention, there is provided a product comprising the amplifier device and provisions for selecting the modes. In this case the optimum signal outputs of the amplifier device in the product can be selected manually or automatically.

According to another preferred embodiment of the invention, there is provided a method for amplifying a radio frequency (RF) signal comprising the steps of:

amplifying the signal in at least a first mode and a second mode by means of amplifier means having at least two modes, said first mode providing high gain and low noise for weak signals, and said second mode providing low gain for handling strong signals.

Preferably, the method further comprises the step of:

- 5                   amplifying the signal in a third mode, said third mode providing high gain and high current for medium signals.

These and other aspects and embodiments of the invention will be apparent from the preferred embodiments(s) described hereinafter.

## 10 BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be more clearly understood from the following description of the preferred embodiments of the invention read in conjunction with the attached drawings, in which:

- Fig. 1 is a circuit diagram showing an amplifier device according to a  
15 preferred embodiment of the invention.

Fig. 2 is a graph showing how the amplifier device in Fig. 1 operates in splitter mode.

Fig. 3 is a graph showing how the amplifier device in Fig. 1 operates in LNA mode.

- 20 Fig. 4 is a flow-chart illustrating a method according a preferred embodiment of the invention.

## DETAILED DESCRIPTION OF THE INVENTION

- Fig. 1 shows a circuit diagram of an amplifier device 10 according to a  
25 preferred embodiment of the invention. The amplifier device 10 comprises an operational amplifier 1 having an output 1a for delivering a radio frequent output signal RF<sub>out</sub> connected in a feedback loop 1c to an input 1b of the amplifier 1 for receiving a radio frequent input signal RF<sub>in</sub>. The feedback loop 1c comprises two different resistors, a first resistor R1 and a second resistor R2 connected in parallel to each other, whereby the resistors R1 and R2 can  
30 be connected in different ways by means of a first switch SW1 connected in series with one of the resistors R1 and R2, in this case the second resistor R2. The first switch SW1 is shown in an OFF position, herein showing a LNA mode. The amplifier device 10 further comprises two resistors controlling the bias of the operational amplifier 1, a third resistor R3, coupled to a voltage V<sub>bias</sub> and a fourth resistor R4 connected to ground, that are coupled to the

amplifier 1 (at the same terminal). The fourth resistor R4 is controlled by means of a second switch SW 2 connected in series with the fourth resistor R4.

The amplifier device (10) can be used as a device coupled to a tuner input or as an improved splitter arranged to supply output signals to at least two tuners.

5 When the amplifier device 10 operates in LNA mode, the second switch SW2 is ON. The operational curve is shown in Fig. 2 showing gain G and noise figure NF plotted versus frequency f. When operating in power splitter mode, the first switch SW1 is ON and second switch SW2 is OFF. The curve of this mode is illustrated in Fig. 3 where gain G and noise figure NF are plotted versus frequency f.

10 The first and second switches SW1 and SW2 are controlled by a mode selecting means 15.

A third mode is achieved when both switches SW1 and SW2 are OFF, whereby a high gain splitter and high current LNA is obtained at the same time. This third mode is intended for a medium strength signal.

15 The mode selection means 15 can be controlled by a button on a remote control device or via another switch on the amplifier device (15) or on a product wherein the amplifier device (15) is present. The mode selection means 15 can also be arranged to be controlled automatically by using an output of a signal to noise ratio detector as can be found in IF-processors.

20 As described, a LNA tuner of today is not always able to handle signals offered by a cable TV system and therefore requires a bypass. Due to implementation loss it suffers an overall deterioration in system performance anywhere from - 1dB (at 50 MHz) to -3 dB (at 860 MHz). By switching this LNA to the splitter mode, which is accomplished by mode selecting means 15 controlling the switches SW1 and SW2 (indicated by dashed lines  
25 in Fig. 1), the amplifier device 10 is also able to handle these cable TV signals without any loss in system performance compared to a "normal" tuner.

In the LNA mode a receiver (not shown) that is coupled to the output of the amplifier device 10 is able to achieve good noise properties (typically low noise) and high gain.

30 In the splitter mode a receiver (not shown) does not suffer from any degradation due to the lower gain of the amplifier device (10) since it is operating in splitter mode. Due to the wide input stage the amplifier device (10) will have the same intermodulation limitation as a splitter.



In the third mode, the gain of the amplifier device is increased while keeping the current high for an intermodulation level between the level of a splitter and LNA mode. In this way, overall system signal to noise (S/N) performance is improved.

Typical performance for an amplifier device according to the invention is:

LNA mode;	RF - IF NF 3 dB, gain > 50 dB
Splitter mode with RF out;	RF - IF NF 8 dB, gain > 40 dB

The invention can also be realized in a method, which will be described below with reference to Fig. 4.

A first step 101 comprises amplifying the signal in at least a first mode and a second mode by means of amplifier means having at least two modes, said first mode providing high gain and low noise for weak signals, and said second mode providing low gain power splitting for handling strong signals.

A second step 102 comprises amplifying the signal in a third mode, said third mode providing high gain and high current for medium signals.

The invention finds application for instance for cable, terrestrial and satellite TV signals.

As used in the following claims, it should be noted that the above-mentioned embodiments illustrate rather than limit the invention, and that those skilled in the art will be able to design many alternative embodiments without departing from the scope of the appended claims. In the claims, any reference signs placed between parentheses shall not be construed as limiting the claim. The word "comprising" does not exclude the presence of elements or steps other than those listed in a claim. The word "a" or "an" preceding an element does not exclude the presence of a plurality of such elements. The invention can be implemented by means of hardware comprising several distinct elements, and by means of a suitably programmed computer. In the device claim enumerating several means, several of these means can be embodied by one and the same item of hardware. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage "comprise" means including, but not necessarily limited to.

## CLAIMS:

1. An amplifier device (10), said amplifier device comprising:  
amplifier (1) means for amplifying a radio frequency input signal RFin,  
a controllable feedback loop (1c) for adjusting a gain and a bias voltage  
applied to the amplifier means (1) for adjusting a current determining a noise level, the  
5 feedback loop and the bias voltage being arranged to provide at least two different modes, a  
first mode providing high gain and low noise for handling weak signals and a second mode  
providing low gain power splitting for handling strong signals.
2. An amplifier device (10) as claimed in claim 1, wherein the amplifier device  
10 (10) comprises a mode selection means (15), and the feedback loop (1c) is connected  
between an output (1a) and an input (1b) of the amplifier means (1), the feedback loop (1c)  
comprising at least a first resistor (R1), and a second resistor (R2) connected in parallel to  
each other, wherein the second resistor (R2) is connected in series with a switch (SW1)  
controlled by the mode selecting means (15), which also controls the bias voltage applied to  
15 the amplifier means (1).
3. An amplifier device (10) as claimed in claim 1, wherein the mode selection  
means (15) are arranged to control the feedback loop (1c) and the bias voltage to provide a  
third mode providing high gain and high current.  
20
4. A product comprising the amplifier device (10) as claimed in claim 1 and  
means for selecting the at least two different modes.
5. A method for amplifying a radio frequency signal, the method comprising the  
25 step of:  
amplifying the signal in at least a first mode and a second mode by means of  
amplifier means having at least two modes, said first mode providing high gain and low noise  
for weak signals, and said second mode providing low gain power splitting for handling  
strong signals.

6. A method according to claim 5, further comprising the step of:  
amplifying the signal in a third mode, said third mode providing high gain and high current  
for medium signals.

## ABSTRACT:

A multimode front stage amplifier and method for amplifying a signal having optimal signal output for weak signals as well as for strong signals provided for TV tuners. A product having a multimode front stage amplifier and provisions for selecting different modes of processing the signal.

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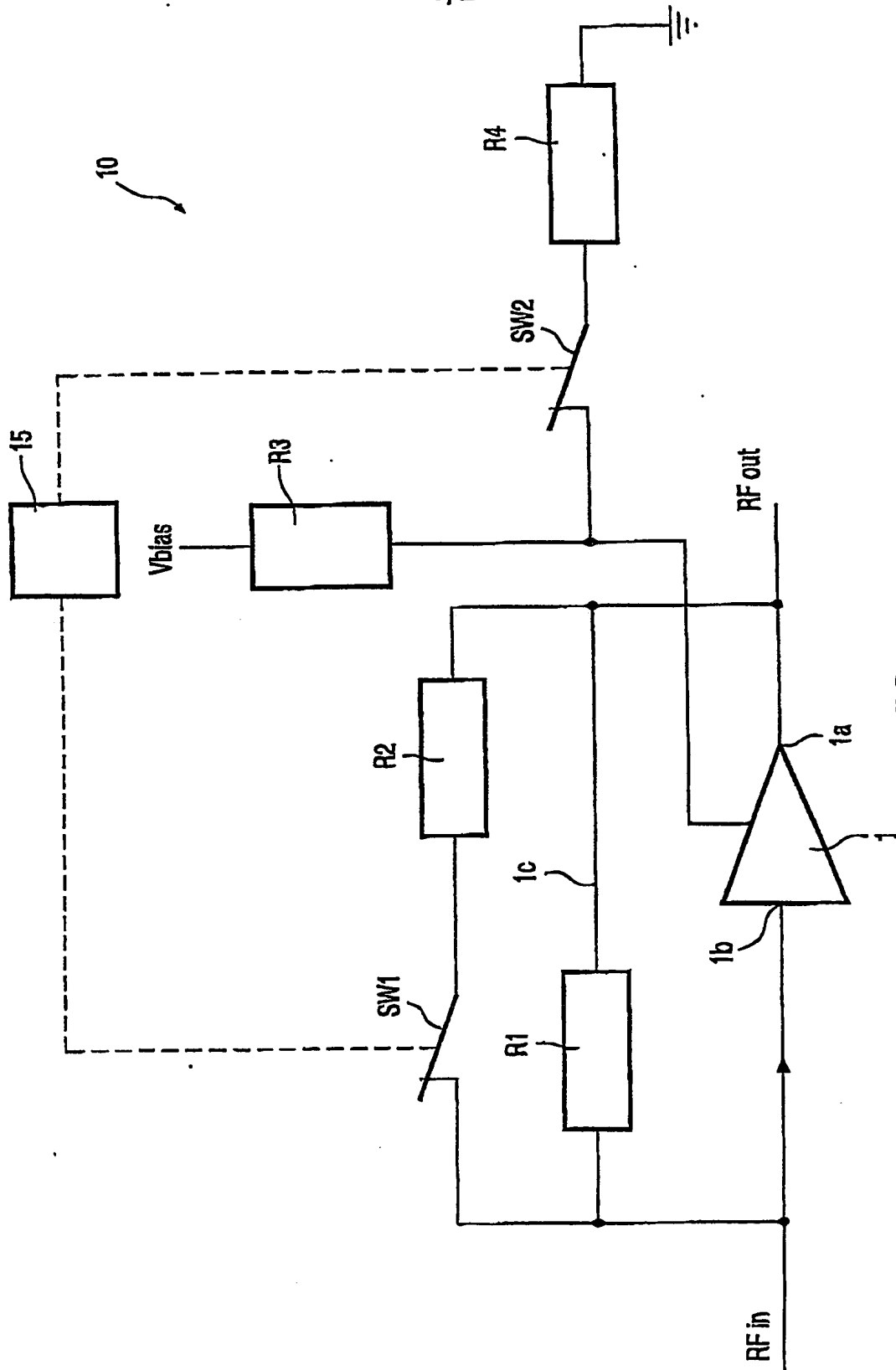


FIG. 1

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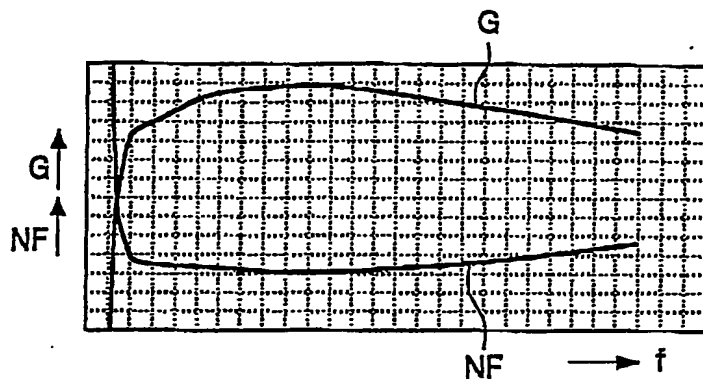


FIG. 2

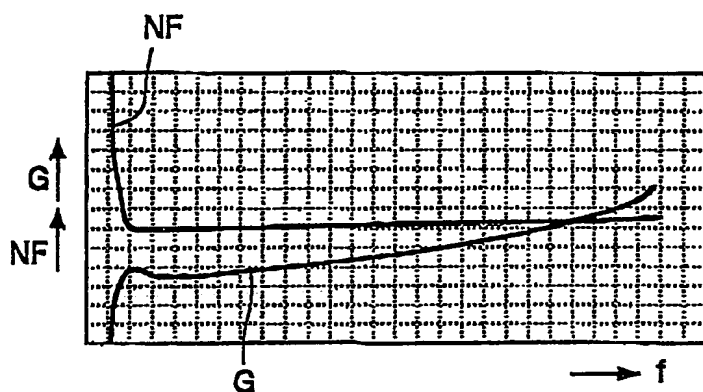


FIG. 3

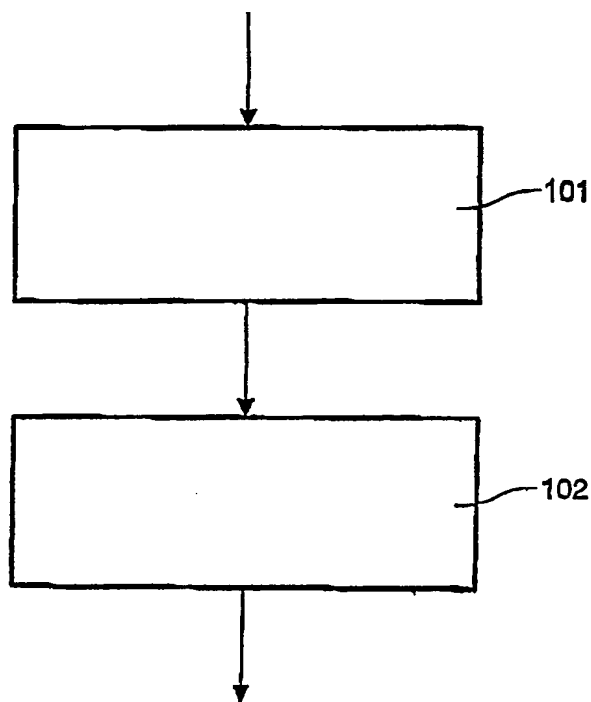


FIG. 4